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VLBI OBSERVING SYSTEM FOR VSOP

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Abstract Submission Form

1996 National Radio Science Meeting

Reference # **0000**
Session 0.00

The VLBI Space Observatory Programme (VSOP) satellite is scheduled for launch in September 1996. It will orbit with a perigee height of 1000 km, an apogee height of 22,000 km, and an inclination of 31°. This paper describes the VLBI observing system for VSOP and its differences from ground radio telescope VLBI systems.

The radio telescope aboard VSOP will have a polyhedral structure with an area equivalent to that of an 8-meter circular antenna. Six extensible trusses will provide the antenna deployment and backup structure. The overall shape of the mesh surface will be maintained by a wire-tension-truss design, which includes several thousand cables anchored to the trusses and to the spacecraft body. Feeds and receivers for observing at 1.6, 4.8, and 22.2 GHz are located at the Cassegrain focus. Aperture efficiencies are expected to be between 40% and 50%, while system temperatures will range from 100 K to 200 K. The on-board science subsystem contains the local-oscillator chain as well as the sampling and digitizing hardware necessary for VLBI observations. For most observations, the two independent intermediate-frequency channels will have bandwidths of 16 MHz each, with 2-bit sampling employed. This 128-Megabit/s observing mode is compatible with VLBA data-acquisition systems.

VSOP carries no VLBI data recorder or high-stability frequency reference, so these must be located on the ground, thousands of kilometers from the rest of the VLBI observing system. A reference tone derived from a hydrogen maser must be uplinked and used to drive all oscillators on the spacecraft. Digitized data must be downlinked and recorded on the ground. Therefore, VLBI observing can take place only when the spacecraft can communicate with a tracking station. A set of five tracking stations will be used for VSOP, providing coverage over 50% to 90% of each orbit,

In addition to the tracking station coverage, there are other significant constraints on VLBI observing with VSOP. First, power considerations prevent observations from being made within 70° of the Sun. Second, the spacecraft orbit precesses rapidly; apogee moves from south to north and back again in about 1.2 years, while the VSOP orbital plane precesses through an entire cycle in about 1.8 years. Third, observations are not possible when tile Earth eclipses the Sun. Hence, the possible (u, v)-plane coverage changes substantially over the course of a few months. When a radio source lies in the orbital plane, nearly l-dimensional (u, v) coverage is obtained. A few months later, the same radio source may lie in a direction perpendicular to the orbital plane, thus permitting improved 2-dimensional (u, v) coverage.

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Date received: 23 May 95
Date formatted: September 19,1995
Form version: 1.0